B4 Cont

107. (New) The high phase order induction machine drive system of claim 51 wherein said alternating current output is variable between: substantially fundamental frequency output, substantially harmonic frequency output, and a combination of fundamental frequency output with superimposed harmonic frequency output.

Response to Examiner's Comments

Oath/Declaration

A new, dated, oath or declaration is submitted.

Objection to the Drawings

The drawings stand objected to under 37 CFR 1.83(a) as not showing every feature of the invention specified in the claims (Office Action mailed 2nd May 2002; item 2).

Applicant has amended claim 34 so it no longer has the feature: "two winding terminals per phase". The mesh connection feature specified in amended claims 34 and 83 is adequately shown in Figures 2 and 3, which illustrate the general concept of the mesh connection of the present invention. Applicant respectfully requests Examiner to withdraw objection to the drawings as not showing every feature of the invention in claims 34 and 83.

Applicant has respectfully requested the cancellation of claim 35 without prejudice.

Applicant has respectfully requested the cancellation of claims 36 and 38 without prejudice.

Applicant has respectfully requested the cancellation of claim 37 without prejudice.

Examiner objects to the drawings as not showing the feature "skip number" specified in claims 39, 41, 44, 46-50 and other related claims. Applicant has respectfully requested that claims 39 and 46 be cancelled without prejudice; other claims have been amended to include the feature "S" (shown in Figures 2 and 3). Where the feature "skip number" is used, it is clear from the specification that this is the same as the feature "S" [e.g. see Page 10, line 18: "In order to determine the value of S (skip number)"]. Applicant

respectfully requests Examiner to withdraw objection to the drawings as not showing every feature of the invention in claims 41, 44, 47-50 and other related claims.

Examiner objects to the drawings as not showing the feature "phase angle difference" specified in claim 40. Other amendments have introduced this feature into claims 34, 47, and 48, and it also occurs in new claims 98 and 99. Figures 2 and 3 show the relative phase angle against each of the inverter terminals. The specification makes it clear that alongside the inverter terminals in the Figures is the phase angle; the paragraph beginning page 6 line 33 makes it equally clear what the phase angle difference is. Applicant respectfully requests Examiner to withdraw objection to the drawings as not showing every feature of the invention in claim 40 and others.

Examiner objects to the drawings as not showing the feature "variable electrical phase angle" specified in claims 42 and 43. Claims 42 and 43 have been amended to remove this feature. Applicant respectfully requests Examiner to withdraw objection to the drawings as not showing every feature of the invention in claims 42 and 43.

Objection to the Specification

The abstract of the disclosure stands objected to because it contains the word "comprising" (Office Action mailed 2nd May 2002; item 3).

Applicant has amended the abstract of the disclosure accordingly, and respectfully submits that the abstract of the disclosure, as amended, is now acceptable.

The disclosure is objected to because of a number of informalities (Office Action mailed 2nd May 2002; item 4).

Applicant has amended the disclosure as requested by Examiner, and respectfully submits that the disclosure, as amended, is now acceptable.

Applicant is enclosing a copy of the amendment filed 4/1/02, which was not in good condition.

Claims Objections

Claim 50 stands objected to under 37 CFR 1.75(c), as being of improper dependent form to further limit the subject matter of a previous claim (Office Action mailed 2nd May 2002; item 5).

Applicant has amended claim 50 accordingly, and respectfully submits that claim 50, as amended, is now of proper dependent form to further limit the subject matter of a previous claim.

Claims Rejections

Claims 34-67 and 83-89 stand rejected under 35 USC 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor, at the time of the application was filed, had possession of the claimed invention (Office Action mailed 2nd May 2002; item 7).

In respect of the rejection because the specification does not clearly show the mesh connection, claimed in claims 34 and 83, Applicant refers examiner to Page 4 and line 30, where it is stated that:

> "The three phase mesh connection is well known in the art, and is commonly known as a delta connection";

to Page 5 line 26, which states that:

> "There are thus a substantial number of choices for how an N phase system may be mesh connected. This set of choices is greatly reduced by rotational symmetry requirements, specifically each winding must be connected to two inverter terminals with the same electrical angle difference between them as for every other winding";

and to Page 6 line 3, which states that:

> "Permissible connections of the N phase windings are either from the center point, to each of the N points on the circle (this being the star connection shown as Fig. 2a) or from each of the N points to another point S points distant in the clockwise direction, where S represents the number of skipped points (inverter terminals)"

Applicant has amended claims 34 and 83 to draw on this language, and respectfully submits that the specification does clearly show the mesh connection claimed in claims 34 and 83, as amended.

In respect of the rejection because Figure 1 does not clearly show the mesh connection, claimed in claims 34 and 83, Applicant refers examiner to Page 5 and line 34, where it is stated that:

> "**Fig. 2** shows N evenly spaced points and a center point. Each of these points represents an inverter terminal **2**, to which one of the terminals of each of one or more motor windings **1** may be connected. Permissible connections of the N phase windings are either from the center point, to each of the N points on the circle (this being the star connection shown as **Fig. 2a**) or from each of the N points to another point S points distant in the clockwise direction, where S represents the number of skipped points (inverter terminals)"

Applicant respectfully submits that, whilst Figure 1 may not clearly show the mesh connection claimed in claims 34 and 83, Figure 2 (and Figure 3) do clearly show the mesh connection.

In respect of the rejection because the drawings do not clearly show how the winding terminals of the phases connected to the terminals of the inverter, claims 34 and 83 have been amended to remove the term "winding terminals per phase", and Applicant respectfully requests that Examiner withdraw this particular rejection.

Claims Rejections - 35 USC 112

Claims 34-67 and 83-89 stand rejected under 35 USC 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention (Office Action mailed 2nd May 2002; item 9).

Applicant has respectfully requested that claims 34-39, 46, 60, 61, 63 and 85-87, be cancelled, without prejudice.

Claims 34 and 83 stand rejected as being indefinite because it is not clearly understood how the mesh connection is carried out. Applicant has amended

claims 34 and 83, and submits that, as amended, they do now particularly point out and distinctly claim how the mesh connection is carried out.

Claim 42 stands rejected for not having sufficient antecedent basis for reciting the limitation "the selectable synthesis". Applicant has amended claim 42, and submits that, as amended, the terms recited therein do now have sufficient antecedent basis.

Claims 44 and 46 stand rejected for not having sufficient antecedent basis for reciting the limitation "the two terminals of each winding". Applicant has requested that claim 46 be cancelled without prejudice, and has amended claim 44, and submits that, as amended, the terms recited therein do now have sufficient antecedent basis.

Claim 45 stands rejected for not having sufficient antecedent basis for reciting the limitation "said electrical phase variability". Applicant has amended claim 45, and submits that, as amended, the terms recited therein do now have sufficient antecedent basis.

Claim 49 stands rejected for not having sufficient antecedent basis for reciting the limitation "the two terminals of different windings". Applicant has amended claim 49, and submits that, as amended, the terms recited therein do now have sufficient antecedent basis.

Claim 67 stands rejected for not having sufficient antecedent basis for reciting the limitation "the drive waveform". Applicant has amended claim 67, and submits that, as amended, the terms recited therein do now have sufficient antecedent basis.

Claims 40, 42, 43, 53, 55, 56 and 58 stand rejected as being unclear in relation to the meaning of the term "minimum electrical phase relation"; claims 47 and 48 stand rejected as being unclear in relation to the meaning of the term "fundamental phase relation". Applicant has amended these claims, and submits that, as amended, the terms recited therein do now have clear meaning.

Claims Rejections - 35 USC 102

Claims 34, 35, 37, and 39-67 stand rejected under 35 USC 102(e) as being anticipated by Kuznetsov, U.S. Pat. No. 6,064,172 (Office Action mailed 2nd May 2002; item 11).

The standard for determining novelty under 35 U.S.C. 102 was set forth by the court in *In re Bartlett*, 300 F.2d 942, 133 USPQ 204 (CCPA 1962). "The degree of difference [from the prior art] required to establish novelty occurs when the average observer takes the new design for a different, and not a modified, already-existing design."

Applicant has respectfully requested that claims 35, 37, 39, 46, 60, 61 and 63 be cancelled, without prejudice.

In regard to the claim 34 rejection, Examiner states the Kuznetsov shows a high phase induction machine drive system, comprising: an induction motor (Figures 5A and 5B) and an inverter system (Figure 5B).

At column 4, lines 28 and 29, Kuznetsov states: "FIG. 5 shows a winding diagram for a 6 phase, 32 pole permanent magnet naval propulsion generator". In a permanent magnet device, the rotating magnetic field is established by the rotation of the permanent magnets; thus a device of this nature is not an induction machine. Furthermore the device depicted in Figure 5 is not a motor; it is a generator. Figures 5a and 5b thus do not show "an induction motor comprising N phases", as recited in claim 34 of the present invention.

In the same column, lines 43-55, Kuznetsov states: "FIG. 5a shows an arrangement whereby each sector phase winding feeds an H bridge rectifier, which may be either a diode rectifier or a controlled rectifier such as a thyristor or insulated gate bipolar transistor (IGBT). Thus the whole machine has a total of 24 H-bridge rectifiers designated blocks 231 through 254. The outputs of the rectifiers may be configured in parallel or in series or a combination thereof; the FIG. 5a shows a parallel grouping of outputs designated DC1, DC2, DC3, DC4. FIG. 5b shows a variation on the basic machine winding as described in Table 5 with the modification of an interconnected rectifier bridge 345, 347, 349, 350 linking all phases of a * particular quadrant. This arrangement reduces the total number of active devices (diodes or thyristors) in the system and permits connecting quadrants in series or in parallel." The current produced in the coils by the rotation of the permanent magnets is fed to rectifiers: these may be individual rectifiers for each coil as shown in Figure 5a, or they may be interconnected as shown in Figure 5b. The rectified current provides direct current output. Figure 5b thus does not

show "an inverter system for the synthesis of a plurality of phases of alternating current output", as recited in claim 34 of the present invention.

The same arguments are applicable to claims 40-45, 47-59, 62, and 64-67.

Applicant respectfully submits that the average observer would take Applicant's invention for a different design to, and not a modification of, Kuznetsov's disclosure, which shows neither and induction motor nor an inverter system.

CONCLUSION

Applicant submits that this application, as amended, is in condition for allowance, and such disposition is earnestly solicited. If the Examiner believes that discussing the application with Applicant might advance the prosecution, I would welcome the opportunity to do so.

Respectfully submitted,

Jonathan Sidney Edelson
Inventor

Version of Amended Claim 34 with markings to show changes made

34. (Amended) A high phase order induction machine drive system, comprising

a) [an induction motor having more than three phases, and having at least two winding terminals per phase, and

b)]an inverter system for the synthesis of a plurality of phases of alternating current output, each phase electrically connected to at least one inverter terminal, and [wherein said alternating current having variable voltage, variable frequency and variable electrical phase angle, said inverter system comprising inverter terminals electrically connected to said winding terminals with a mesh connection.]

b) an induction motor comprising N phases, where N is greater than 3, connected mesh to said inverter terminals, said mesh characterized in that:

each motor phase is electrically connected to a first inverter terminal and a second inverter terminal S + 1 inverter terminals distant from the first inverter terminal in order of electrical phase angle, where S is the skip number, and

the phase angle difference between the pair of inverter terminals to which each motor phase is connected is identical for each motor phase.

Version of Amended Claim 40 with markings to show changes made

40. (Amended) The high phase order induction machine drive system of claim 3[5]4 wherein said [two winding terminals of each of said phases are driven by the inverter system with a phase angle difference of close to but not exactly]phase angle difference is approximately 120 electrical degrees[when said inverter system is synthesizing output of fundamental phase relation].

Version of Amended Claim 41 with markings to show changes made

41. (Amended) The high phase order induction machine drive system of claim 3[5]4 wherein [said motor comprising N phases where]N is [either]a multiple of 3[or not], and [wherein if N is a multiple of 3, said mesh connection being arranged with a skip number of]S = N/3[, and wherein if N is not a multiple of 3, said mesh connection being arranged with a skip number of (N/3)-1 rounded to the nearest integer].

Version of Amended Claim 42 with markings to show changes made

42. (Amended) The high phase order induction machine drive system of claim [41]35 wherein said [variable electrical phase angle comprising the]alternating current output is selectable [synthesis]between [current with]a fundamental [phase relation]frequency component and [current with]a fundamental [phase relation]frequency component multiplied by three.

Version of Amended Claim 43 with markings to show changes made

43. (Amended) The high phase order induction machine drive system of claim [41]34 wherein said [variable electrical phase]alternating current output compris[ing]es a variable proportion of [current with]a fundamental [phase relation]frequency component and [current with]a third harmonic [phase relation]frequency component.

Version of Amended Claim 44 with markings to show changes made

44. (Amended) The high phase order induction machine drive system of claim [41]34 wherein [said motor comprising]N = 17 [phases and]wherein [said mesh connection arranged with a skip number of]S = 5[between the two terminals of each winding].

Version of Amended Claim 45 with markings to show changes made

45. (Amended) The high phase order induction machine drive system of claim [41]34 wherein said [electrical phase variability of said]inverter output[system] compris[ing]es a variable degree of a third harmonic component superimpos[ition]ed upon the fundamental [phase relation of said inverter]frequency component.

Version of Amended Claim 47 with markings to show changes made

47. (Amended) The high phase order induction machine drive system of claim 3[5]4 wherein [said mesh connection is defined as having a skip number of]S = (N-3)/2, [where N is the number of phases of said induction motor,]and wherein said alternating current output is variable between: an increase in the phase angle difference[is further defined as: an electrical phase increase] in response to a signal to increase the impedance of the motor, a[n] decrease in the electrical phase [decrease]difference as a response to a signal to decrease the impedance of the motor, and a minimum electrical phase [relation comprising]angle difference corresponding to the fundamental [electrical phase relation]frequency.

Version of Amended Claim 48 with markings to show changes made

48. (Amended) The high phase order induction machine drive system of claim 3[5]4 wherein [said mesh connection is defined as having a skip number of]S = 0, and wherein said alternating current output is variable between: an increase in the phase angle difference[is further defined as an electrical phase increase] in response to a signal to decrease the impedance of the motor, [and]a[n] decrease in the electrical phase [decrease]angle difference as a response to a signal to increase the impedance of the motor, and a minimum electrical phase [relation comprising]angle difference corresponding to the fundamental [relation]frequency.

Version of Amended Claim 49 with markings to show changes made

49. (Amended) The high phase order induction machine drive system of claim 3[5]4 wherein [said motor having N phases where]N is [any]odd[number greater than three, and wherein said mesh connection comprising each inverter terminal being connected to two winding terminals of different windings].

Version of Amended Claim 50 with markings to show changes made

50. (Amended) The high phase order induction machine drive system of claim [16]34 wherein said [mesh connection having a skip number of]S = (N-3)/2.

Version of Amended Claim 51 with markings to show changes made

51. (Amended) The high phase order induction machine drive system of claim 3[5]4 wherein [said motor having N phases where]N is any even number greater than 4 and wherein said mesh connection compris[ing]es a plurality of mesh subsets wherein each subset compris[ing]es an odd number of phases.

Version of Amended Claim 52 with markings to show changes made

52. (Amended) The high phase order induction machine drive system of claim 51 each of said subsets having a skip number [of skipped terminals within that subset,]of N/3, if N is a factor of 3; and (N/3)-1, rounded to the nearest integer, if N is not a factor of 3.

Version of Amended Claim 53 with markings to show changes made

53. (Amended) The high phase order induction machine drive system of claim 52 wherein said [variable electrical phase of said]alternating current output[of said inverter system] compris[ing]es a variable proportion of [current with]a fundamental [phase relation]frequency component and [current with]a third harmonic [phase relation]frequency component.

Version of Amended Claim 54 with markings to show changes made

54. (Amended) The high phase order induction machine drive system of claim 51 wherein said subsets having a skip number [of skipped terminals within that subset,]of (N-3)/2.

Version of Amended Claim 55 with markings to show changes made

55. (Amended) The high phase order induction machine drive system of claim 51 wherein said [variable electrical phase of said]alternating current output[of said inverter] compris[ing]es harmonic [waveforms instead of the fundamental phase relation drive waveform current]frequency components.

Version of Amended Claim 56 with markings to show changes made

56. (Amended) The high phase order induction machine drive system of claim 51 wherein said [variable electrical phase of said]alternating current output[of said inverter] compris[ing]es [superimposed]harmonic [waveforms]components superimposed upon [the]a fundamental [phase relation drive waveform current]frequency component.

Version of Amended Claim 57 with markings to show changes made

57. (Amended) The high phase order induction machine drive system of claim 5[1]6 wherein said [superimposed]harmonic [waveforms]compris[ing]e only odd order harmonics.

Version of Amended Claim 58 with markings to show changes made

58. (Amended) The high phase order induction machine drive system of claim [51]34 wherein said [superimposed harmonic waveforms upon the fundamental phase relation drive waveform current,]alternating current output compris[ing]es a square wave[s] component.

Version of Amended Claim 59 with markings to show changes made

59. (Amended) The high phase order induction machine drive system of claim 3[5]4 further comprising a receptor for receiving signals to vary the impedance of the motor, and wherein said [variable electrical phase of said]alternating current [of said inverter]output compris[ing]es variable harmonic content to the waveform according to the signals received by the receptor.

Version of Amended Claim 62 with markings to show changes made

62. (Amended) The high phase order induction machine drive system of claim 3[5]4 wherein [said mesh connection comprising the two terminals of each winding phase being connected with a skip number of zero]S = 0.

Version of Amended Claim 64 with markings to show changes made

64. (Amended) The high phase order induction machine drive system of claim 3[5]4 wherein [said motor having 9 or more phases]N ≥ 9.

Version of Amended Claim 65 with markings to show changes made

65. (Amended) The high phase order induction machine drive system of claim 3[5]4 wherein said motor having 18 phases divided into two subsets of nine phases, wherein each subset having a separate mesh connection with a skip number of 3 within that subset.

Version of Amended Claim 66 with markings to show changes made

66. (Amended) The high phase order induction machine drive system of claim 3[5]4 wherein said motor is a linear induction motor.

Version of Amended Claim 67 with markings to show changes made

67. (Amended) The high phase order induction machine drive system of claim 3[5]4 wherein said windings comprise single inductors per slot[, and wherein said variable electrical phase comprising variable odd and even order harmonic application to the drive waveform].

Version of Amended Claim 83 with markings to show changes made

83. (Amended) A high phase order motor having more than three phases, connected to inverter output elements with a mesh connection, said mesh characterized in that: each motor phase is electrically connected to a first inverter terminal and a second inverter terminal S + 1 inverter terminals distant from the first inverter terminal in order of electrical phase angle, where S is the skip number, and the phase angle difference between the pair of inverter terminals to which each motor phase is connected is identical for each motor phase.

Version of Amended Claim 84 with markings to show changes made

84. (Amended) The high phase order motor of claim 83, [in which the skip number of the mesh connection is the highest skip number possible that allows for rotational symmetry]wherein S = (N-3)/2.

Version of Amended Claim 88 with markings to show changes made

88. (Amended) The high phase order motor of claim 83 wherein [said mesh connection having a skip number of zero]S = 0.

Version of Amended Claim 89 with markings to show changes made

89. (Amended) The high phase order motor of claim 83 wherein [said mesh connection having a skip number of]S = (N/3)-1, rounded to the nearest integer.